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Presence of zoonotichelminths in cats (*Feliscatus*) of condominiums in City of Mexico with special concern to *Toxocara cati* infection

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Summary

The toxocariasis is a soil-transmitted helminthiasis (SHT) of worldwide distribution, caused by the intestinal helminths of the dog and the cat *Toxocaracanis* and *Toxocaracati*, respectively. The toxocariasis by *T. cati* is little studied worldwide.

Objective: Determine the prevalence of *T. cati* infection and other intestinal zoonotic parasites in domestic cats that live in condominium apartments in Mexico City.

Material and Methods: With Faust's method, 121 feces of cats living in apartments in a condominium in Mexico City were analyzed. A questionnaire was applied to the owners to obtain hygienic habits of the animal. The statistical analysis was performed with the Chi-square and Fisher's exact tests with a confidence level of $p < 0.05$.

Results: The prevalence of *T. cati* infection was 33.1%. Embryonated eggs were observed in 8.26% $p < 0.000$; oocysts of *Toxoplasma gondii* 6.6% and eggs and larvae of *Ancylostomatids* 1.6%. The association of *Ancylostoma* spp. and *T. gondii* sp. was significant ($p < 0.004$). The highest frequency of infection was found in cats under 12 months of age. However, the presence of *T. cati* in the different age groups was $p < 0.000$.

Conclusion: The coexistence with parasitized animals is a risk to acquire different intestinal zoonoses transmitted by the cat as toxocariasis. However, the presence within the home of larvae eggs of *T. cati* and oocysts of *T. gondii* increases the risk of infection in younger children and people suffering from some type of immune deficiency.

Keywords

Cats; Toxocariasis; *Toxocaracati*; Toxoplasmosis; Condominiums

Introduction

The toxocariasis is a soil-transmitted helminthiasis (HTS) of worldwide distribution. Its epidemiological clinical importance lies in the fact that its main transmission mechanism involves the profuse contamination of the soil with fecal matter that evacuates two of the pets that closely coexist with the human being, the cat and the dog. Toxocariasis is caused by the intestinal helminths of the dog and the cat *Toxocaracanis* and *Toxocaracati*, respectively [1-3].

Both animals are infected by different mechanisms such as: ingestion of embryonated eggs, migration through the placenta of larvae that have remained in the tissues of the mother, ingestion of larvae present in breast milk and the consumption of paratenic hosts with the infective larvae [4]. The female of both helminths produces eggs that are eliminated along with their own fecal matter of the host, thus contaminating the ground of streets, parks and gardens, places where young children usually play, thereby facilitating the transmission, infection and dissemination of the parasitosis. In the soil, the eggs of *T. cati* and other STH must reach their infective form (embryonated eggs) in a period of 3-4 weeks. In this way, human infection is the result of the involuntary ingestion of embryonated eggs or larvae present in the tissues of a range of domestic and wild paratenic hosts [5]. In the small intestine, released larvae penetrate the intestinal wall and via the bloodstream they spread to different tissues, but do not complete their normal migration to the intestine to reach the adult stage; in this way, the larvae, as they wander through the tissues, produce visceral larva migrans (VLM) and ocular larva migrans (OLM) syndromes. Both pathologies constitute a serious public health and diagnostic problem, both for health institutions and for the general practitioner [6-8].

The toxocariasis is mainly a benign infection so the vast majority of those infected is asymptomatic or have very few symptoms, so they are not diagnosed. Infection is suspected due to accidental findings of persistent eosinophilia [9,10]. Visceral toxocariasis occurs

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preferentially in children from 1 to 4 years of age with a history of geophagy. Clinically, it is characterized by fever, pulmonary signs and symptoms, hepatosplenomegaly and leukocytosis with marked eosinophilia [11,12]. Cases of neurological alterations have been reported that are manifested by seizures, paralysis, epilepsy and sometimes cause death when the number of larvae in the central nervous system is high [13,14]. In ocular toxocariasis, the larvae produce strabismus, leukocoria, endophthalmitis, chronic inflammation of the tissues of the posterior chamber or chronic granulomas in the retina, alterations that can cause blindness in the affected eye [8,14].

People who live in condominiums do not escape this problem, due to the fecal contamination produced daily by dogs and family cats and vagabonds in the children's recreational areas. However, the danger is not only restricted to fecal contamination of common areas but is also latent in the interior of the department, mainly those in which they live with cats parasitized by *T. cati*. In these homes the most common way to control cat evacuations is to provide a box containing sand (litter box), in this way the sand is not being changed frequently and becomes a reservoir and source of infection for the residents and the cat itself, due to that *T. cati* eggs reach their infective form (embryonated eggs) in a period of 3-4 weeks; main characteristic of STH. This way, the risk of acquiring the parasitosis when accidentally ingesting the embryonated eggs is greater, mainly for children under 6 years of age. However, none of the relatives is exempt from developing the aforementioned clinical events. Based on the foregoing and the scarce information that exists in the national and global literature on the role of *T. cati* as an etiological agent of human toxocariasis, it was proposed to carry out the present investigation oriented to know the frequency of infection by the nematode in domestic cats that live in apartments in a condominium in housing units of Mexico City.

The objective of this study was to determine the prevalence of *T. cati* infection and other intestinal zoonotic parasites in domestic cats that live in condominium apartments in the Tlalpan Delegation, Mexico City.

Material and Methods

Study area

The Dr. Ignacio Chávez housing unit is located in the Coapa Farms Colony in Alcaldía Tlalpan, Mexico City. In the limits between the Coyoacan and Xochimilco mayoralties. The climate is temperate sub-humid, average annual temperature 12 °C. It has a population of 650,567 inhabitants [15].

Study design

During the month of October 2017, a cross-sectional descriptive exploratory study was carried out with the purpose of knowing the prevalence of *T. cati* and other enteroparasites transmitted by the domestic cat in the Dr. Ignacio Chávez housing unit.

Study Population

A housing unit located in the Tlalpan mayorality was selected for the ease of access and the proximity to the UAM-X facilities. Through a direct interview, the study protocol was explained to each condominium owner and was invited to participate. Simultaneously, a questionnaire was applied that included general information such as name, age, sex, race, type of feeding, place of defecation and date of deworming of the pet. They were also instructed in the form and management of fecal matter. Once the participation was accepted, a stool sample container was delivered containing 50 mL of 10% formalin diluted in 0.85% Isotonic Saline Solution (ISS). At the time of delivery, the general data of each feline address, name, age, gender, and race were verified; placed in a portable cold unit for transfer to the laboratory. Fecal samples were collected before 12 o'clock.

Stool examination

The processing of the samples and the parasitological diagnosis was carried out in the Human Parasitology Laboratory of the Department of Health Care of the Autonomous Metropolitan University Xochimilco Unit. Initially, each sample was subjected

to a macroscopic examination with the intention of observing and identifying adult worms and/or proglottids of cestodes. Subsequently, each fecal sample was processed via the flotation concentration method with zinc sulphate 1.18, fresh preparations with lugol were made with the supernatant, and were observed under Carl Zeiss clear field microscopes at 100x and 400x [16]. The identification of the parasites was carried out according to their morphological characteristics [17].

Statistical analysis

The data obtained was organized and codified in a database in SPSS (Statistical Package for Social Science) version 21.0 for Windows (SPSS Inc., Chicago IL, USA). From the variables used in data processing (age, gender, race presence of enteroparasites, disposition of excreta) association relations, graphs and tables were created which allowed to have a quantitative description of the studied population. In the search for association between variables, the Chi-square and Fisher exact statistical tests were used with a level of significance of 0.05%.

Results

For the study of transmission-infection risk factors towards man by *T. cati*, the study included the analysis of fecal matter of 121 domestic cats from 2 to 96 months of age. Table 1 shows the distribution of the cats analyzed by sex and age groups, 62.8% males and 37.2% females. The highest frequency of animals was found in the group of more than 12 and less than 36 months of age (55.4%). Table 2 shows the finding and level of general infection by parasites diagnosed in the feces analyzed. The prevalence of *T. cati* infection was 33.1%. Embryonated eggs of *T. cati* were observed in 8.26% of the feces; oocysts of *T. gondii* 6.6% and eggs and larvae of ancylostomatids 1.6%. Table 3 records the frequency of *T. cati* infection in the age groups, 21 cats were less than 12 months of age. Table 4 shows the association between the identified parasite species. The association of *Ancylostoma* spp and *T. gondii* was significant ($p < 0.004$). The presence of embryonated eggs of *T. cati* $p < 0.000$. The infection by *T. cati* in the different age groups was significant $p < 0.000$.

Discussion

In urban areas of developing countries, the possibility of environmental contamination by human and animal fecal matter is relatively controlled, due to the accelerated urbanization process that provides basic services of drinking water, sewerage and garbage collection among others. However, environmental pollution caused by fecal matter from pets (dogs and cats) is directly related to the cultural habits of the population, which favors the dispersal of feces in public and private places. In this way, people who live in condominiums in any city in the world can acquire parasitic diseases such as toxocariasis transmitted by the dog and the cat, or toxoplasmosis caused by the protozoan *T. gondii* transmitted by the cat. Both parasitoses are considered worldwide as the main parasitic zoonoses transmitted by the dog and the cat [18,19].

However, toxocariasis caused by *T. cati* in Mexico is a poorly studied helminthiasis despite the indiscriminate increase in feline population. Because people who live in apartments in condominium use cats as pets, and not as natural predators of rodents.

Age	Absolute frequency		Percentage		
	Male	Female	Male	Female	Total
12 months or less	23	11	19.0	9.1	28.1
More than 12 and less than 36	43	24	35.5	19.8	55.4
More than 36 meses	10	10	8.3	8.3	16.5
Total	76	45	62.8	37.2	100.0

Table 1: Distribution by sex and age group of the 121 cats analyzed from the Dr. Ignacio Chávez Housing Unit.

Parasite	Percentage			Negative	Positive	Total
	Negative	Positive	Total			
<i>Toxocara cati</i>	81	40	121	66.9	33.1	100.0
<i>Ancylostomatidos</i>	119	2	121	98.3	1.7	100.0
<i>Toxoplasma gondii</i>	113	8	121	93.4	6.6	100.0

Table 2: Frequency of infection by parasites in analysed cats from the Dr. Ignacio Chávez Housing Unit.

Age	Negative	Positive	Total
12 months or less	13	21	34
More than 12 and less than 36	52	15	67
More than 36 months	16	4	20
Total	81	40	121

Table 3: Distribution by age group of infected cats by *T. cati*.

Variables		Estimate dp	
		Chi-square	Fisher
<i>Ancylostomatids</i>	<i>Toxoplasma gondii</i>	0.000	0.004
<i>T. cati</i>	embryonated eggs	0.000	0.000
Mites		0.002	

Table 4: Association found between parasites using the Chi-square and Fisher exact statistical tests

The present work contributes to the knowledge of the epidemiology of toxocariasis in domestic felines living in apartments in condominiums, as it provides information on the frequency of *T. cati* in cats of a megalopolis, and in this way assess in part the magnitude of this problem, as well as the risk that the inhabitants have of acquiring this and other intestinal parasitosis when living voluntarily or involuntarily with infected felines. The results obtained in this work confirm the above since different species of helminths and protozoa are found in the stool samples of cats.

The presence of *T. cati* in the departments that participated in the study is quite high and is an indicator of the risk for the inhabitants of acquiring toxocariasis when living with an animal entrusted to a narrow, closed and parasitized place by this helminth. As indicated by the finding of embryonated eggs of *T. cati* in this site ($p < 0.000$). The permanence of fecal material in the sandbox for prolonged periods favors the development of the eggs to their infecting state (embryonated egg) that can remain viable for several months, due to the thick crust that protects it from environmental changes. In this way, the sandbox becomes a reservoir that favors the infection, reinfection and dissemination of the embryonated eggs throughout the house by the cat, due to their indiscriminate habits of resting when lying down all over the furniture and the floor in the house. The threat of infection by *T. cati* in the condominiums is especially greater for children under 6 years of age whose hygienic habits are still precarious, in addition to having greater contact with animals. However, the danger diminishes with the daily and adequate elimination of feces. Additionally, administering a quarterly treatment scheme for deworming preferably with parasitological control. In the case of kittens, treatment should begin a few days after being infected by the mother through milk, and continue with the biweekly scheme for the first three months and then every three months.

A greater risk for condominium owners is the finding in this study of *T. gondii* oocysts in the cats analyzed $p < 0.002$. Especially for people who suffer from some type of immune deficiency (AIDS). In people with AIDS, toxoplasmosis is the main cause of central nervous system (CNS) injuries and death. In pregnant women, congenital

infection with *T. gondii* has devastating effects on the newborn such as chorioretinitis, intracranial calcifications, hydrocephalus and central nervous system disorders that lead to neurological deficiencies (psychomotor, seizures and mental retardation [20-23].

Although it is true that the size of the sample of cats analyzed in this study does not allow defining the real prevalence of toxocariasis in the feline population of Mexico City. The results point to the possible importance of this zoonotic disease. The 33.1% frequency obtained here is comparable to the 31.8% reported for several provinces in Canada; and in a lower proportion to 24% of Athens Greece; 26% in Oklajoma, USA; 26% in Lancashire, England; 44.4% in Denmark; 5.4% Finland [1,24-28]. The frequencies increase in studies carried out in populations of street cats 38.1% of Lisbon, Portugal and up to 78% in Azarshahr of East Azerbaijan, Iran [18,29].

These results show that it does not matter the country where this type of studies are carried out, but that it is undeniable that toxocariasis is today the parasitic zoonosis caused by helminths of greater importance in public health in any country in the world. Despite the availability of highly effective anthelmintics for dogs and cats, we must insist on promoting responsible pet ownership with the active participation of the owners and the obligation to provide them with well-being, adequate nutrition, medical attention from a veterinarian for vaccination, deworming and sterilization. The education and responsibility of the owners are fundamental in the prevention of different zoonoses that afflict them. However, the vast majority lack of them.

Each one of the factors involved in the development and transmission of toxocariasis implies the decisive participation of the different governmental authorities and society itself, since without the support of the first and the collaboration of the second, the solution to this problem is very far from reaching. The knowledge of the epidemiology of toxocariasis, and of other parasitic zoonoses transmitted by the cat, is of special importance to implement preventive and control measures that allow diminishing the presence and spread of infectious forms in the environment of *T. cati*, which is the source of infection, mainly for young children. Therefore, it is very important to disseminate knowledge of the epidemiology of toxocariasis because of the risk it represents to public health.

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